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(54) PRODUCTION OF GLASS PLATE AND DEVICE FOR PRODUCING THE SAME

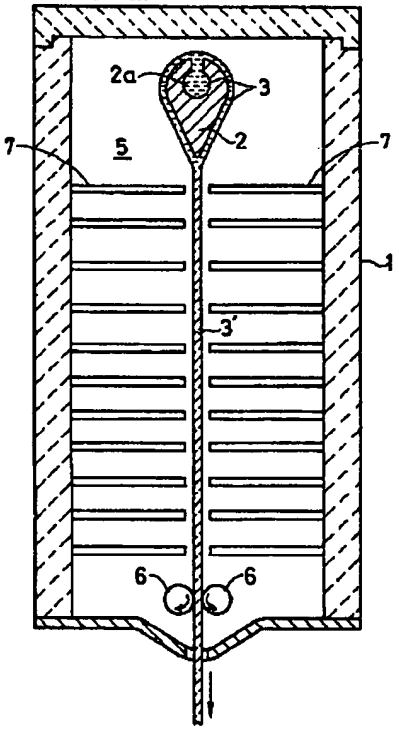
1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.**** shows the word which can not be translated.

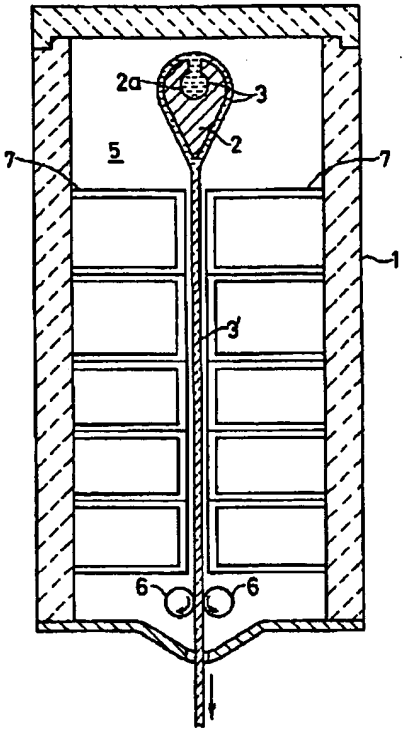
3.In the drawings, any words are not translated.

DRAWINGS

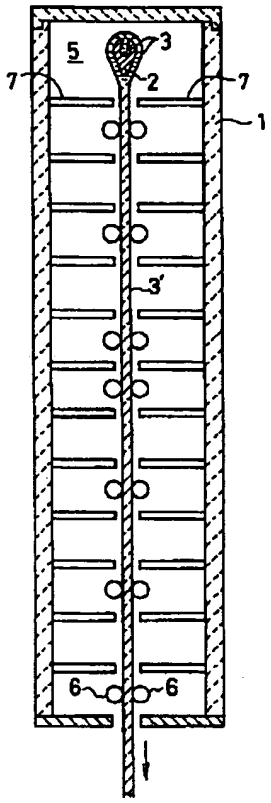
[Drawing 1]

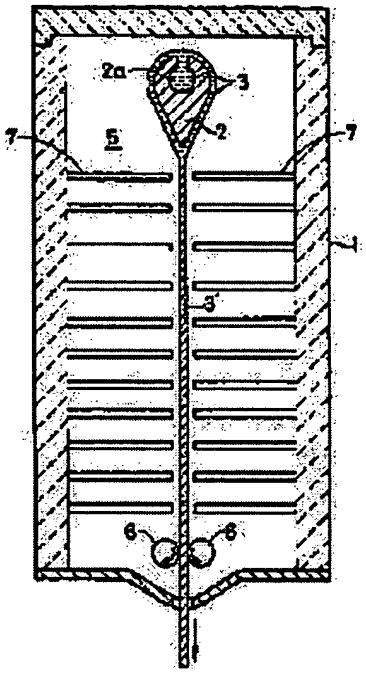


[Drawing 2]



[Drawing 3]





(57)Abstract:
PROBLEM TO BE SOLVED: To provide a device for producing a glass plate, enabling to produce the glass plate little in curvature.
SOLUTION: This device for producing a glass plate is provided with a shaping form 2 for shaping molten glass 3 into a plate-like shape and with pulling rollers 6 for pulling out the cooled glass plate 3', wherein the form 2 and the pulling rollers 6 are arranged at a space therebetween the in the vertical direction. Therein, a plurality of bulkheads 7 for separating the oven room 6 in the vertical direction are arranged, and a room temperature controller for controlling the temperature of the room is disposed for each separated room to control an average cooling speed between the glass transition point of the glass and its strain point to 1.2° C/sec.

CLAIMS

[Claim(s)]

[Claim 1] The manufacture approach of the glass plate which establish a ******** room in plurality, and said two or more ** are made to carry out sequential advance of the glass plate, and is characterized by cooling a glass plate gradually so that it may be the manufacture approach of a glass plate of manufacturing a glass plate by fabricating melting glass to tabular and cooling with hauling and temperature may fall one by one to the travelling direction of glass.

[Claim 2] The manufacture approach of the glass plate according to claim 1 characterized by making the average cooling rate from this glass transition point to a strain point into below 1.2-degreeC / second in the cooling process of the glass which cools a glass plate gradually.

[Claim 3] The manufacture approach of the glass plate characterized by making into below 1.2-degreeC / second the average cooling rate from this glass transition point in the cooling process of the glass which is the manufacture approach of a glass plate

of fabricating melting glass to tabular and manufacturing a glass plate by cooling, and was fabricated by tabular to a strain point.

[Claim 4] The manufacture approach of a glass plate given in any of claims 1-3 characterized by making the average cooling rate from the above-mentioned glass transition point to a strain point into below 1.0-degreeC / second they are.

[Claim 5] The manufacture approach of a glass plate given in any of claims 1-4 characterized by making the average cooling rate from the above-mentioned glass transition point to a strain point into 0.4-0.9-degreeC / second they are.

[Claim 6] The manufacture approach of a glass plate given in any of claims 1-5 characterized by the average line coefficient of thermal expansion to 100-300-degreeC of the above-mentioned glass being 80x10-7 - 110x10-7/ **C they are.

[Claim 7] The glass substrate for information record media characterized by using the glass plate manufactured by the manufacture approach of a glass plate given in any of claims 1-6 they are.

[Claim 8] The magnetic-recording medium characterized by preparing a magnetic layer at least on the glass substrate for information record media according to claim 7.

[Claim 9] The manufacturing installation of the glass plate characterized by making into below 1.2-degreeC / second the average cooling rate from this glass transition point in the cooling process of the glass which is the manufacturing installation of a glass plate which fabricates melting glass to tabular and manufactures a glass plate by cooling, and was fabricated by tabular to a strain point.

[Claim 10] The manufacturing installation of a glass plate given in the claim 9 characterized by making the average cooling rate from the above-mentioned glass transition point to a strain point into 0.4-0.9-degreeC / second.

[Claim 11] The manufacturing installation of the glass plate which establish a ******** room in plurality, and said two or more ** are made to carry out sequential advance of the glass plate, and is characterized by cooling a glass plate gradually so that it may be the manufacturing installation of a glass plate which fabricates melting glass to tabular and manufactures a glass plate by cooling and temperature may fall one by one to the travelling direction of glass.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] It can apply to manufacture of various glass plates about the manufacture approach of the glass plate which fabricates melting glass to tabular and draws out this cooled tabular glass, and the manufacturing installation of a glass plate, and is especially suitable for the glass substrate for information record media.

[0002]

[Description of the Prior Art] A full call type raising method, a float glass process, etc. which pull up the down draw method which draws out a glass plate in a perpendicular lower part, and a glass plate to the perpendicular upper part as the manufacture approaches of a glass plate are known.

[0003] On the other hand, make it flow down melting glass along the both-sides side of a wedge-like Plastic solid as a formula, it is made to join in the lower limit section of a Plastic solid, and there are some which fabricate a glass plate by [of a down draw method] pulling cooling gradually and pulling caudad with a roller.

[0004] After forming horizontally the septum which separates the shaping ambient atmosphere and cooling ambient atmosphere of a glass plate in JP,5-139766,A as an example of the manufacturing installation of the glass plate of a down draw method and fabricating glass to tabular, it cools promptly and the manufacturing installation of the glass plate which prevents that glass contracts and the board width of a glass plate becomes small is indicated.

[0005] Conventionally, the glass plate used for the display boards, such as liquid crystal which consists of alkali free glass, was manufactured, using the manufacturing installation of such a glass plate.

[0006]

[Problem(s) to be Solved by the Invention] On the other hand, the need of a glass plate is increasing as a substrate for information record media, such as a magnetic disk drive, in recent years. That in which the average line coefficient of thermal expansion from 100-degreeC to 300-degreeC has the comparatively big average line coefficient of thermal expansion which are 80x10-7 - 110x10-7 / **C grade is used for such a glass plate for the substrates of an information record medium.

[0007] It considers as the glass preferably used for such glass substrates for information record media, for example, the following glass is mentioned.

[0008] As glass which can give a deep compression layer, the high anti-chip box reinforcement based on this, and high Knoop hardness to the chemically strengthened glass which has the outstanding ion-exchange engine performance and was obtained

according to the ion exchange, first, by weight % SiO2 60 - 75%, and aluminum 2O3 5 - 18%, 2O4 - 10% of Li(s), 2O4 - 12% of Na, and ZrO2 The glass contained 5.5 to 15% is mentioned.

[0009] Moreover, ZrO2 It is SiO2 at weight % as glass which prevents generating of a non-melt and gives the glass for chemical strengthenings with a flat front face. 58 - 75%, and aluminum 2O3 5 - 18%, 2O3 - 10% of Li(s), 2O4 - 12% of Na, and ZrO2 The glass contained less than 5.5% is mentioned.

[0010] Moreover, B-2 O3 As glass which is easy to fuse including alkaline earth metal, it is SiO2 at weight %. 58 - 75%, and B-2 O3 1 - 10%, and aluminum 2O3 The glass which Na2 O contains 4 to 11% 3 to 10%, and MgO and CaO contain [Li2 O] 2 to 12% with a total amount is mentioned 5 to 18%.

[0011] Moreover, the glass used for the glass plate for the substrates of an information record medium has the flume description into which a big distortion tends to remain at the time of shaping, and a line coefficient of thermal expansion tends to be divided at it since it is large compared with alkali free glass, more than twice and.

[0012] By the conventional manufacture approach, manufacture of such a glass plate produces the problem that a glass plate breaks or the curvature of a glass plate becomes large. It is thought that these phenomena originate in the special heat characteristic of the glass plate used for the substrate for information record media.

[0013] It is made in order that this invention may solve the above-mentioned trouble, and it aims at offering the manufacture approach of the glass plate which can make the curvature of a glass plate small.

[0014]

[Means for Solving the Problem] By fabricating melting glass to tabular and cooling with hauling, invention of claim 1 is the manufacture approach of a glass plate of manufacturing a glass plate, it establishes a ******** room in plurality, makes said two or more ** carry out sequential advance of the glass plate, and is characterized by cooling a glass plate gradually so that temperature may fall one by one to the travelling direction of glass.

[0015] Invention of claim 2 is characterized by making the average cooling rate from this glass transition point to a strain point into below 1.2-degreeC / second in the manufacture approach of a glass plate according to claim 1 in the cooling process of the glass which cools a glass plate gradually.

[0016] By fabricating melting glass to tabular and cooling, invention of claim 3 is the manufacture approach of a glass plate of manufacturing a glass plate, and is characterized by making into below 1.2-degreeC / second the average cooling rate

from this glass transition point in the cooling process of the glass fabricated by tabular to a strain point.

[0017] Invention of claim 4 is characterized by making the average cooling rate from the above-mentioned glass transition point to a strain point into below 1.0-degreeC / second in the manufacture approach of a glass plate given in any of claims 1-3 they are.

[0018] Invention of claim 5 is characterized by making the average cooling rate from the above-mentioned glass transition point to a strain point into 0.4-0.9-degreeC / second in the manufacture approach of a glass plate given in any of claims 1-4 they are.

[0019] Invention of claim 6 is characterized by the average line coefficient of thermal expansion to 100-300-degreeC of the above-mentioned glass being 80x10-7 - 110x10-7/ **C in the manufacture approach of a glass plate given in any of claims 1-5 they are.

[0020] The glass substrate for information record media of invention of claim 7 is characterized by using the glass plate manufactured by the manufacture approach of a glass plate given in any of claims 1-6 they are.

[0021] The magnetic-recording medium of invention of claim 8 is characterized by preparing a magnetic layer at least on the glass substrate for information record media according to claim 7.

[0022] By fabricating melting glass to tabular and cooling, invention of claim 9 is a manufacturing installation of a glass plate which manufactures a glass plate, and is characterized by making into below 1.2-degreeC / second the average cooling rate from this glass transition point in the cooling process of the glass fabricated by tabular to a strain point.

[0023] Invention of claim 10 is characterized by making claim 9 the average cooling rate from the above-mentioned glass transition point to a strain point in the manufacturing installation of the glass plate of a publication at 0.4-0.9-degreeC / second.

[0024] By fabricating melting glass to tabular and cooling, invention of claim 11 is a manufacturing installation of a glass plate which manufactures a glass plate, it establishes a ******** room in plurality, makes said two or more ** carry out sequential advance of the glass plate, and is characterized by cooling a glass plate gradually so that temperature may fall one by one to the travelling direction of glass.

[0025] In this invention, by making the average cooling rate from the glass transition point of this glass at the time of shaping of glass to a strain point into 1.2-degreeC /

second, distortion is made small, it is divided and curvature is prevented. The range where this cooling rate is desirable is 0.4-0.9-degreeC / second, and more desirable range is 0.6-0.7-degreeC / second. By carrying out a cooling rate 0.4-degreeC / more than a second, cooling can be shortened and the miniaturization of equipment is attained.

[0026]

[Embodiment of the Invention] Hereafter, the gestalt of implementation of the manufacture approach of the glass plate by this invention is explained to a detail, referring to a drawing.

[0027] (Gestalt of the 1st operation) Drawing 1 is drawing having shown roughly the longitudinal section of the glass plate manufacturing installation in the gestalt of the 1st operation. In addition, the glass plate manufacturing installation in the gestalt of the 1st operation consists of a furnace wall 1, Plastic solid 2, the furnace room 5, the hauling roller 6 and a septum 7, and a melting glass supply pipe that is not illustrated.

[0028] A furnace wall 1 consists of a fireproof board which covers a firebrick and this, and, as for Plastic solid 2, the cross section has become wedge-like mostly. Although Plastic solid 2 in the gestalt of this operation is called the so-called feeding cel which has crevice 2a which holds melting glass 3, the thing of other classes may be used for it. Crevice 2a of Plastic solid 2 is connected to the melting glass supply pipe which is not illustrated. The melting glass 3 supplied from this melting glass supply pipe overflows from top slit-like opening of crevice 2a, flows down along the both-sides side of Plastic solid 2, and joins in the lower limit section of Plastic solid 2. It is immediately cooled in the furnace room 5, and the melting glass 3 which joined becomes glass plate 3', and is caudad drawn out by the hauling roller 6.

[0029] The septum 7 which separates the furnace room 5 under Plastic solid 2 was formed in the vertical direction 11 one side (22 both sides), the furnace room 5 was divided into the manufacturing installation of the glass plate of the gestalt of the 1st operation, and the room-temperature-control equipment equipped with the Nichrome heater which controls whenever [room temperature] which is not illustrated is formed in it for every **.

[0030] The temperature of each separated ** was controlled by the gestalt of the 1st operation sequentially from the top to 520-degreeC, 510-degreeC, 500-degreeC, 480-degreeC, 440-degreeC, 400-degreeC, 360-degreeC, 320-degreeC, 280-degreeC, 240-degreeC, 200-degreeC, and 160-degreeC, respectively.

[0031] The manufacturing installation of such a glass plate is used and it is SiO2. 63.5% and aluminum 2O3 8.2%, 2O8.0% of Li(s), 2O10.4% of Na, and ZrO2 From the glass

included 11.9%, with width-of-face [of 600mm] and a thickness of 1.1mm glass plate 3' was drawn out and manufactured by 1.2cm/second in shaping rate. In addition, the strain point of this glass is 458-degreeC, a glass transition point is 500-degreeC, and the average line coefficient of thermal expansion from 100-degreeC to 300-degreeC is 90x10-7/ **C. Moreover, the average cooling rates from the glass transition point at this time to a strain point were 0.63-degreeC / second.

[0032] Thus, the maximum of curvature [in / in the manufactured glass plate / the range of 600mm around] was 300 micrometers.

[0033] On the other hand, it manufactured using the manufacturing installation of the conventional glass plate as an example of a comparison. In addition, the average cooling rates from the glass transition point at this time to a strain point were 1.30-degreeC / second. Thus, the maximum of curvature [in / in the manufactured glass plate / the range of 600mm around] was 2mm or more.

[0034] According to the gestalt of the 1st operation, two or more septa separate a furnace room as mentioned above. Control the temperature of each ** by room-temperature-control equipment, and the average cooling rate from a glass transition point to a strain point is made into 0.63-degreeC / second. By manufacturing the glass plate of 90x10-7/ **C, the average line coefficient of thermal expansion from 100-degreeC to 300-degreeC can make the curvature of a glass plate small, and can prevent the crack of glass.

[0035] The glass plate manufactured still as mentioned above was cut, it considered as the glass substrate for magnetic disks of 66mmphi, and about 20A of surface roughness Rmax(es) was made through the sand or ****** of a low grain [1000 / #400 and / #] after beveling processing. At this time, since the curvature of a glass plate was small, the polish process was simplified and the glass substrate for magnetic disks has been manufactured cheaply.

[0036] Then, the chemical strengthening of the low temperature form ion exchange treatment was performed and carried out to the above-mentioned glass substrate for magnetic disks. Next, the substrate layer which consists of aluminum (50A of thickness)/Cr(1000A)/CrMo (10A), the magnetic layer which consists of CoPtCr(120A)/CrMo(50A)/CoPtCr (120A), and Cr (50A) protective layer were formed in both sides of a substrate with the inline-type sputtering system.

[0037] dipping this substrate in the organic silicon compound solution (mixed liquor of water, isopropyl alcohol, and a tetra-ethoxy silane) which distributed the silica particle (particle size of 100A), and calcinating it -- SiO2 from -- the becoming protective layer was formed, DIP processing of this protective layer top was further carried out

to the lubricant which consists of a perphloro polyether, the lubricating layer was formed, and the magnetic disk for MR heads was obtained.

[0038] When the surfacing trial of the magnetic head was performed about this magnetic disk, not causing a head crash was checked. Moreover, it turned out that the surfacing height of the magnetic head can be made lower and it has the advantage that it can respond to the densification of a magnetic disk.

[0039] (Gestalt of the 2nd operation) Drawing 2 is drawing having shown roughly the longitudinal section of the glass plate manufacturing installation in the gestalt of the 2nd operation. As for the septum 7 shown in drawing 2 , unlike the gestalt of the 1st operation, the cross section is the configuration of the character of KO. In addition, since other parts of the glass plate manufacturing installation in the gestalt of the 2nd operation function as the gestalt of the 1st operation similarly, the explanation is omitted.

[0040] The septum 7 is made of the fireproof quality of the material, and is formed in the both sides of glass plate 3' almost in parallel with glass plate 3'. In fact, as for the distance between a septum 7 and a glass plate, the way of the upper part is large, and the distance in the topmost part of 15mm or less and a septum 7 is set as 1.0mm or less for the distance in the topmost part of a septum 7. In addition, in order to make effect of the open air hard to be influenced, the narrower one of spacing of a septum 7 and glass plate 3' is desirable.

[0041] With the gestalt of the 2nd operation, five septa 7 pile up up and down, and are installed. In addition, the cross section of each septum 7 has bent into the character of KO, and the edge of the bent part has led to the furnace wall 1.

[0042] Having formed the room-temperature-control equipment equipped with the Nichrome heater which controls whenever [room temperature / of each ** divided also into the manufacturing installation of the glass plate of the gestalt of the 2nd operation by the septum] which is not illustrated, the temperature of each separated ** is controlled to predetermined temperature, respectively.

[0043] By [above] using the manufacturing installation of the glass plate of the gestalt of the 2nd operation, the same effectiveness as the gestalt of the 1st operation can be done so.

[0044] (Gestalt of other operations) The glass substrate for the information record media of this invention processes grinding, polish, etc. into the glass plate obtained by the manufacture approach of the glass plate of this invention, and is obtained by forming in a desired configuration. Polish is performed after the usual polish approach by [which are depended on abrasive powder, such as wrapping (sand credit) and

cerium oxide,] carrying out polishing processing.

[0045] Furthermore, the magnetic layer was prepared in the above-mentioned glass substrate for information record media at least, and the magnetic-recording medium by this invention performs chemical-strengthening processing to the front face of the glass substrate for the above-mentioned information record media, for example, subsequently carries out the laminating of a substrate layer, a magnetic layer, a protective layer, the lubricating layer, etc. one by one, and is manufactured.

[0046] As a substrate layer in a magnetic-recording medium, non-magnetic layers, such as Cr, Mo, Ta, Ti, W, and aluminum, are mentioned, and it is good also as multilayer substrate layers, such as aluminum/Cr/CrMo.

[0047] It is also as multilayer configurations, such as CoPtCr/CrMo/CoPtCr which magnetic thin films which use Co as a principal component, such as CoPtCr and CoNiCrTa, were mentioned as a magnetic layer, divided the magnetic layer by the non-magnetic layer, and aimed at reduction of a noise, and is **.

[0048] As a protective layer, Cr film, Cr alloy film, a carbon film, the zirconia film, the silica film, etc. are mentioned, for example. These protective layers can be continuously formed with an inline-type sputtering system with a substrate layer, a magnetic layer, etc. Moreover, these protective layers are good also as a multilayer configuration which consists of film the same or of a different kind well also as a monolayer.

[0049] The protective layer of further others may be formed in the above-mentioned protective layer. For example, a tetra-alkoxy run may be diluted and applied with the solvent of an alcoholic system on the above-mentioned protective layer, it may calcinate further, and the silicon oxide (SiO2) film may be formed.

[0050] Generally a lubricating layer dilutes the perphloro polyether (PFPE) which is a fluid lubrication agent with solvents, such as a Freon system, applies it to a solution front face with a dipping method, a spin coat method, and a spray method, if needed, heat-treats and is formed.

[0051] This invention is not limited to the thing of the gestalt of the above-mentioned operation, and permits various deformation.

[0052] Although the gestalt of the above-mentioned operation showed the manufacturing installation of the glass plate of the down draw method which draws out a glass plate in a perpendicular lower part, this invention is applicable also like the manufacturing installation of the glass plate of other shaping approaches, such as for example, a full call type and a float glass process.

[0053] Moreover, although the gestalt of the above-mentioned operation showed what

formed the septum which separates a furnace room 11 one side (22 both sides), the number of furnace rooms and spacing may be set to arbitration. It may pull similarly and the number of rollers may also be set to arbitration. The cross section of the manufacturing installation of a glass plate which pulled in the septum of 12 one side (24 both sides) and seven one side (14 both sides), and formed the roller in the furnace interior of a room at drawing 3 was shown.

[0054] Furthermore, although the cross section showed what piled up four septa of the configuration of the character of KO with the gestalt of the 2nd operation, the number of septa may be set to arbitration.

[0055] The configuration of a septum is not limited to the gestalt of the above-mentioned operation, either, and the thing of other configurations may be used further again. Moreover, the manufacturing installation of the same glass plate may be equipped with the septum of two kinds of configurations which the manufacturing installation of the same glass plate may be equipped with the septum of two or more kinds of configurations, for example, showed it with the gestalt of the 1st and the 2nd operation.

[0056]

[Effect of the Invention] As explained above, since the average cooling rate from the glass transition point of this glass to a strain point was adjusted to below 1.2-degreeC / second at the cooling process of a glass plate according to this invention, the curvature of a glass plate can be made small and the crack of glass can be prevented.

[0057] Moreover, curvature is small, has the outstanding surface smoothness, and can manufacture cheaply the glass substrate for information record media of this invention.

[0058] Furthermore, by the magnetic-recording medium of this invention, since it has the surface smoothness excellent in the glass substrate, a head crash is not caused. Furthermore, by the magnetic-recording medium of this invention, the surfacing height of the magnetic head can be made lower and it has the advantage that it can respond to the densification of a magnetic-recording medium. Moreover, since the glass plate obtained by this invention has high display flatness, it only performs easy polish etc., can obtain the glass substrate of which high surface smoothness is required, and can manufacture it very cheaply compared with the former.